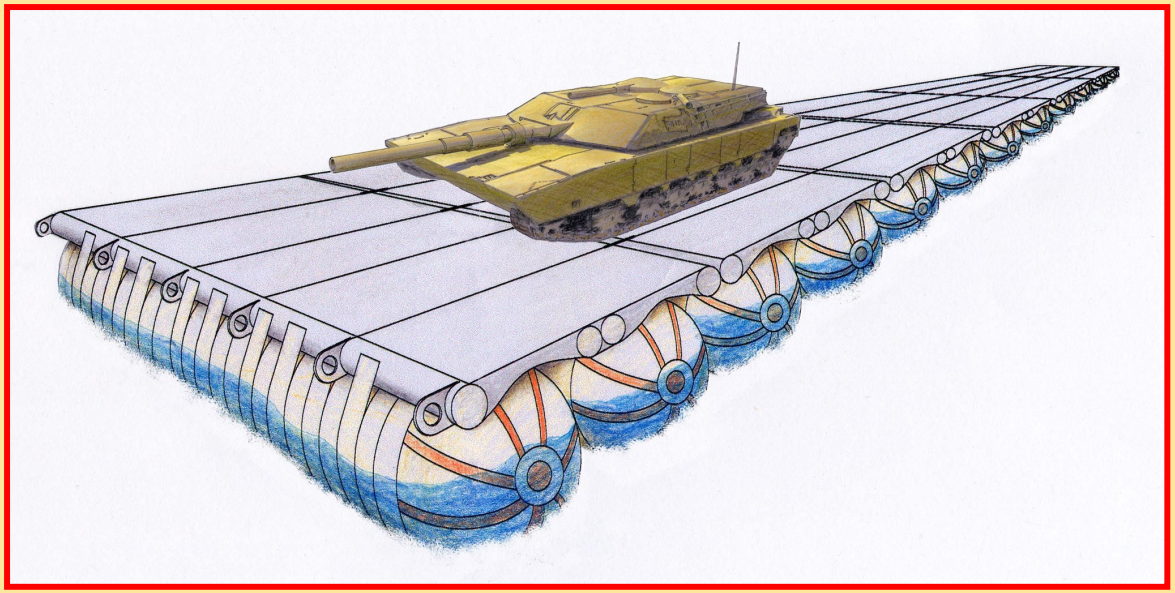
ERDC
Engineer Research and Development Center



LIGHTWEIGHT MODULAR CAUSEWAY SECTION (LMCS) RESEARCH & DEVELOPMENT FOR TSV APPLICATIONS

Quantum Engineering Design, Inc.

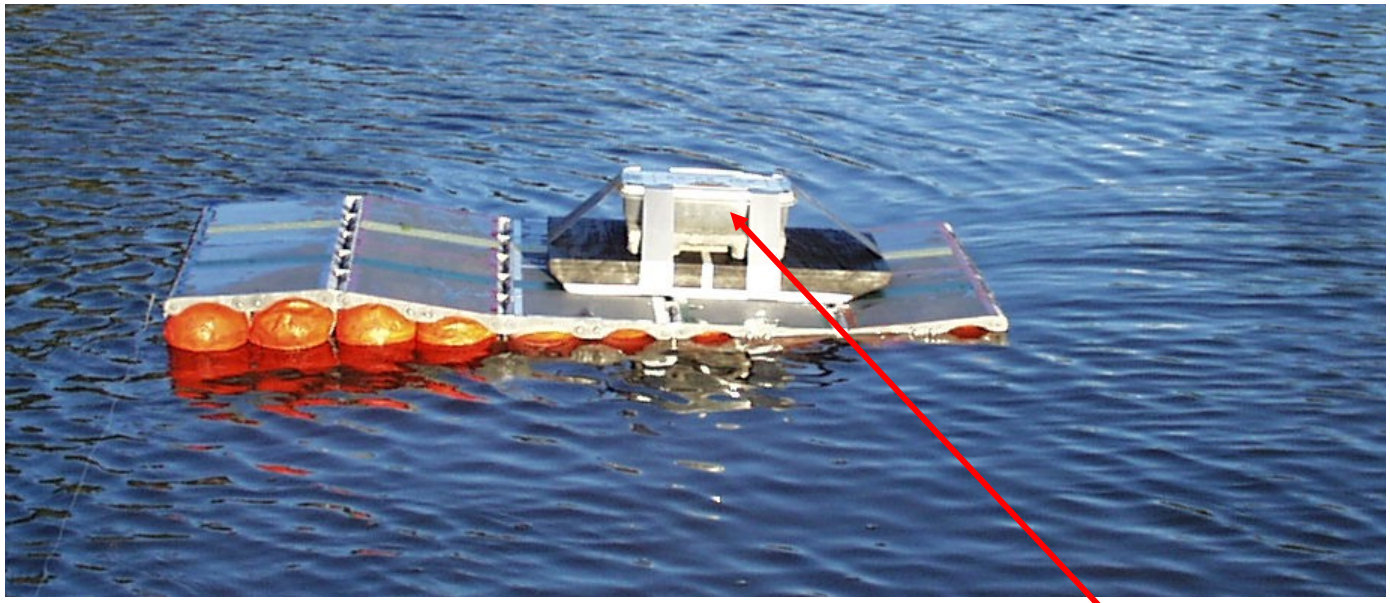
LIGHTWEIGHT MODULAR CAUSEWAY SECTION (LMCS)

TOPICS

- Buoyancy and Stability Characteristics of the LMCS Concept.
  - 1/12th Scale Model Buoyancy & Stability Tests
  - Failure Mode Evaluation
- Flotation Geometry Study
- Inflated Structure
  - Damage Containment & Mitigation
  - Air Containment Concepts

LIGHTWEIGHT MODULAR CAUSEWAY SECTION (LMCS)

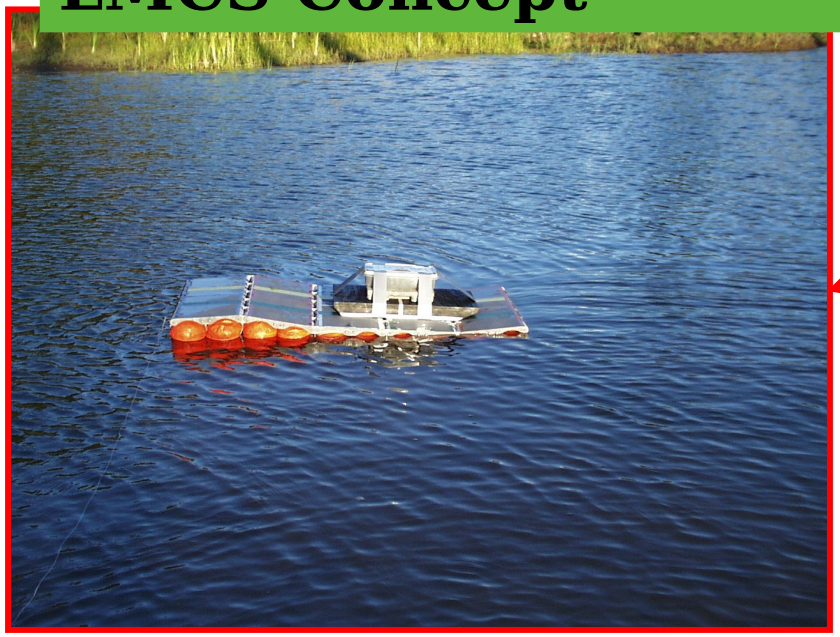
Buoyancy and Stability Characteristics of the LMCS Concept



A payload of a simulated Abrams tank (74 short tons) is positioned amidships to ascertain floatation characteristics.

LIGHTWEIGHT MODULAR CAUSEWAY SECTION (LMCS)

Buoyancy and Stability Characteristics of the LMCS Concept



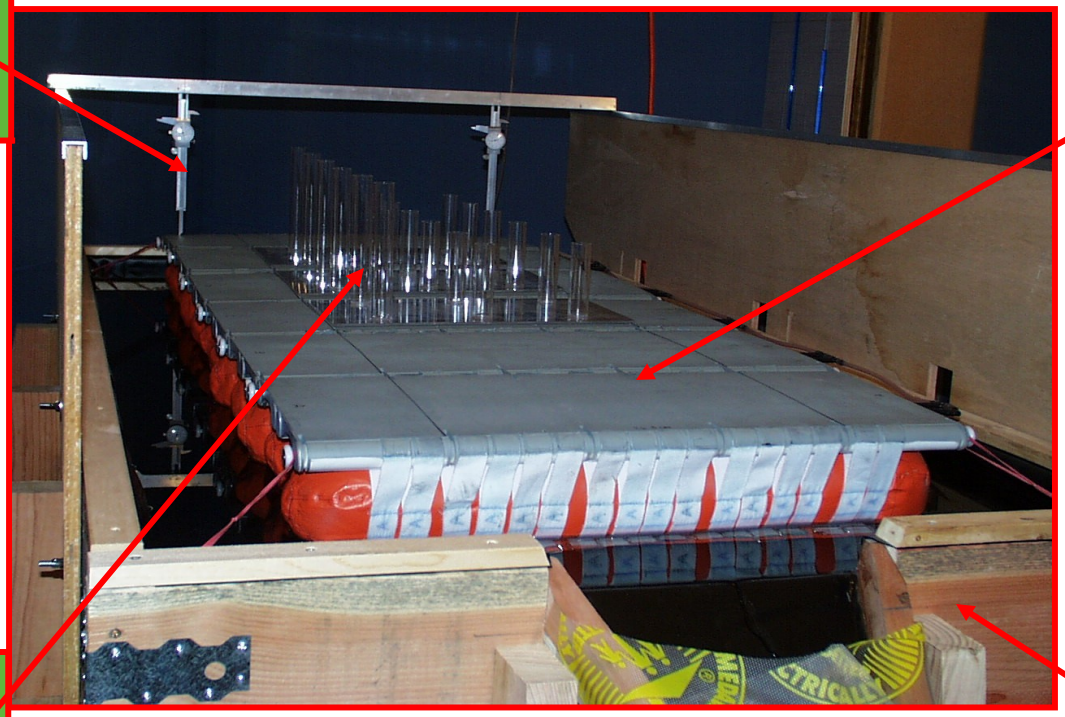
QED, Inc.
Calibrated Test Facility
(1 Acre Pond)

QED, Inc.
Calibrated Cat
(Weight 25 lbs)

1/12-Scale LMCS Buoyancy & Stability Tests

- The purpose of the tests was to evaluate the load-carrying capacity of the LMCS concept.
- The model was set in a special-purpose, water-filled tank with means of measuring attitude of each float and applied loads.
- All data was recorded on Excel spreadsheet.
- Photographs were taken of key test features.

1/12-Scale LMCS Buoyancy & Stability Tests



Calibration Method For Deck Position

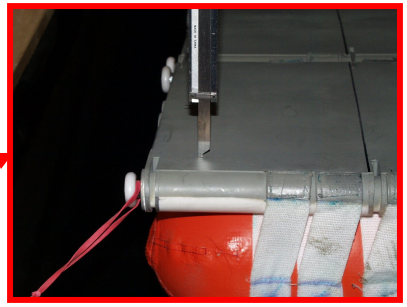
1/12th Scale Model

Place Holders For Positioning Weights

Purpose Built Tank

1/12-Scale LMCS Buoyancy & Stability Tests

LMSC modules heave position measured at fixed points



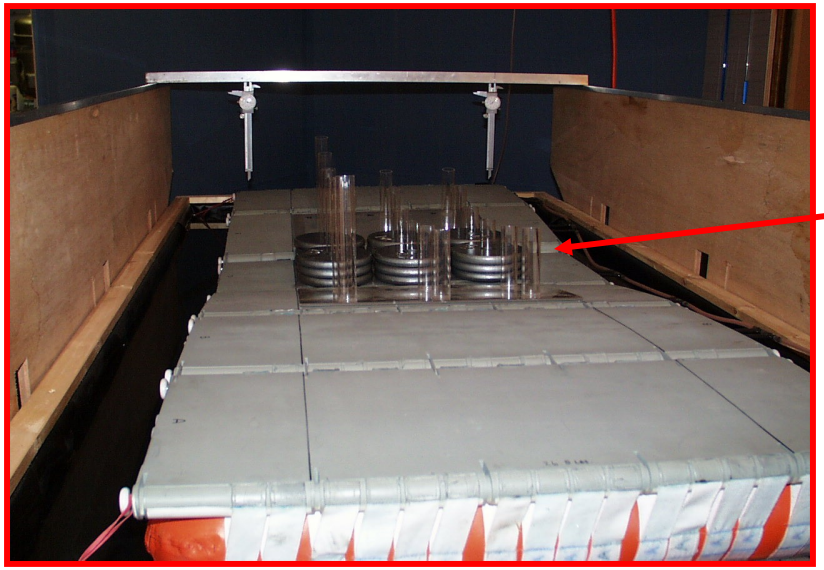
Pressure in bladders carefully controlled

1/12-Scale LMCS Buoyancy & Stability Tests

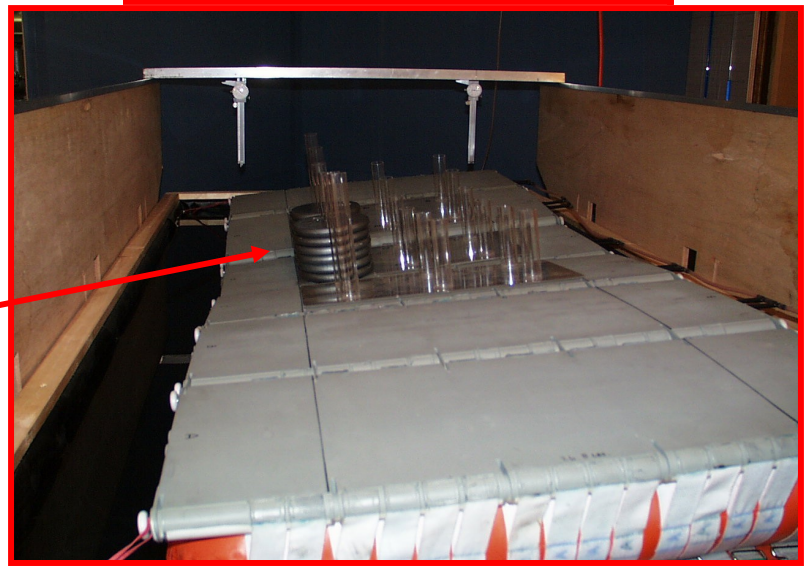
- Model float identifiers
- Model weight locations
- Corner locations for height measurements

The vertical location of all four corners of all six floats were read for each test run

1/12-Scale LMCS Buoyancy & Stability Tests



Weights were added in precise locations and recorded along with platform position and bladder pressure



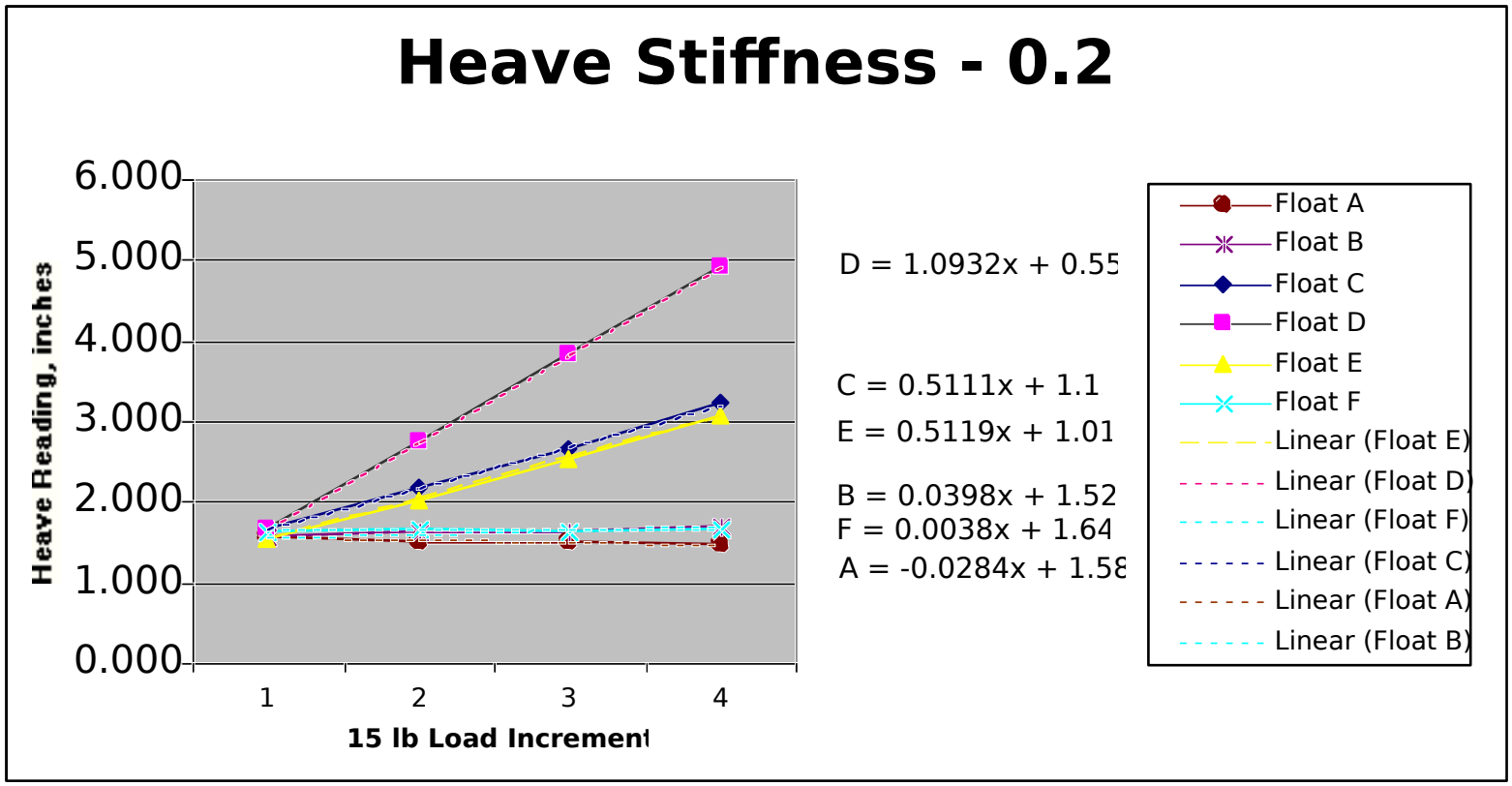
Roll characteristics were evaluated by off-setting weights

1/12-Scale LMCS Buoyancy & Stability Tests

- Runs 1-7 Pressure set to 0.2 psi
  (5.5 inches on water-filled manometer)
- Runs 8-22 Pressure set to 0.6 psi
  (15.5 inches on water-filled manometer)
- Runs 23-36 Pressure set to 0.6 psi
  (31 inches on water-filled manometer)
- Runs 37-45 Forward tube under Float D
  vented to represent failure mode
- Runs 1-4 Adding weights to Float D only
- Runs 5-6 Moving rows of weights forward

LIGHTWEIGHT MODULAR CAUSEWAY SECTION (LMCS)

1/12-Scale LMCS Buoyancy & Stability Tests



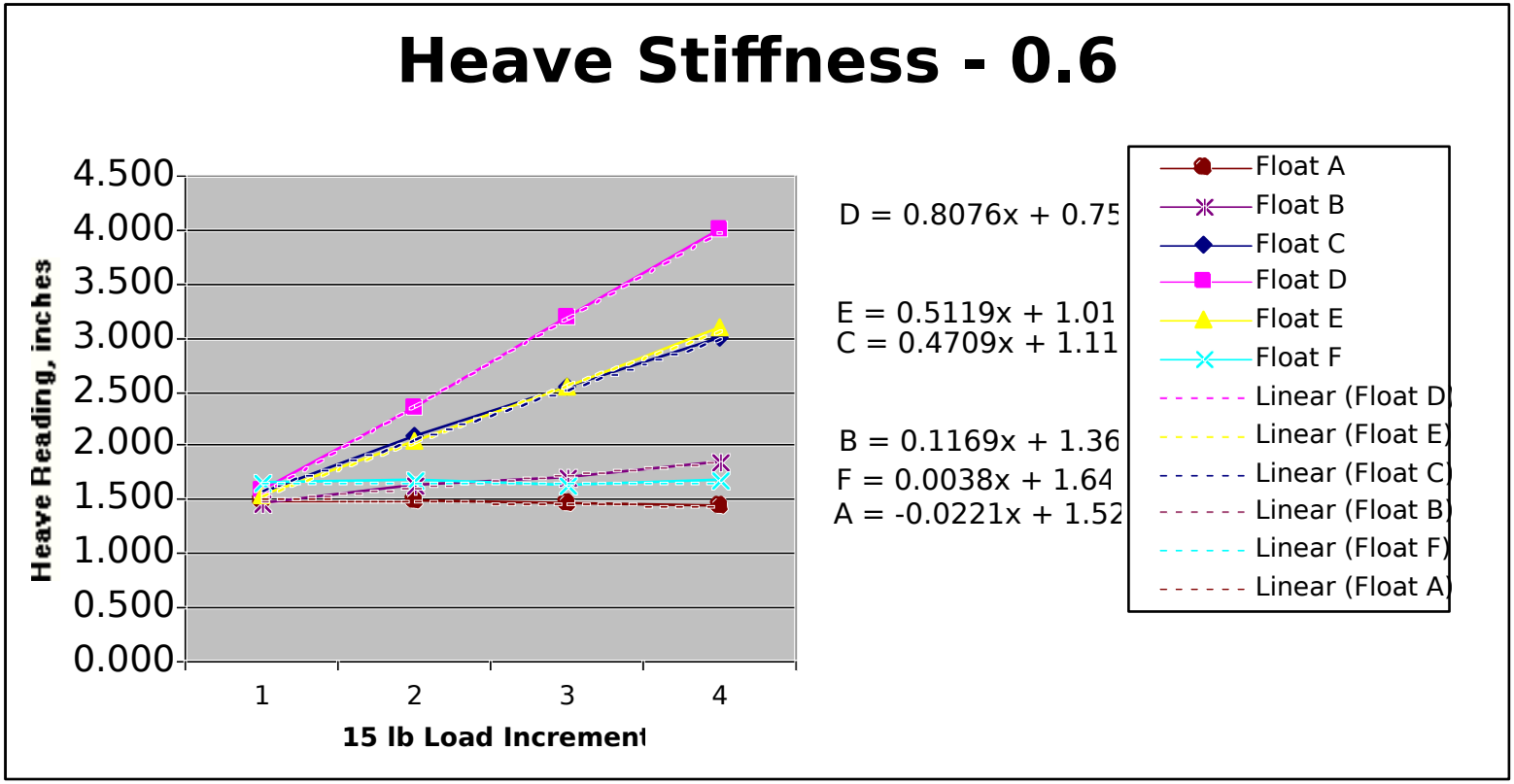
Runs 1-4. Heave stiffness is very linear

ERDC Engineer Research and Development Center

Quantum Engineering Design, Inc.

LIGHTWEIGHT MODULAR CAUSEWAY SECTION (LMCS)

1/12-Scale LMCS Buoyancy & Stability Tests



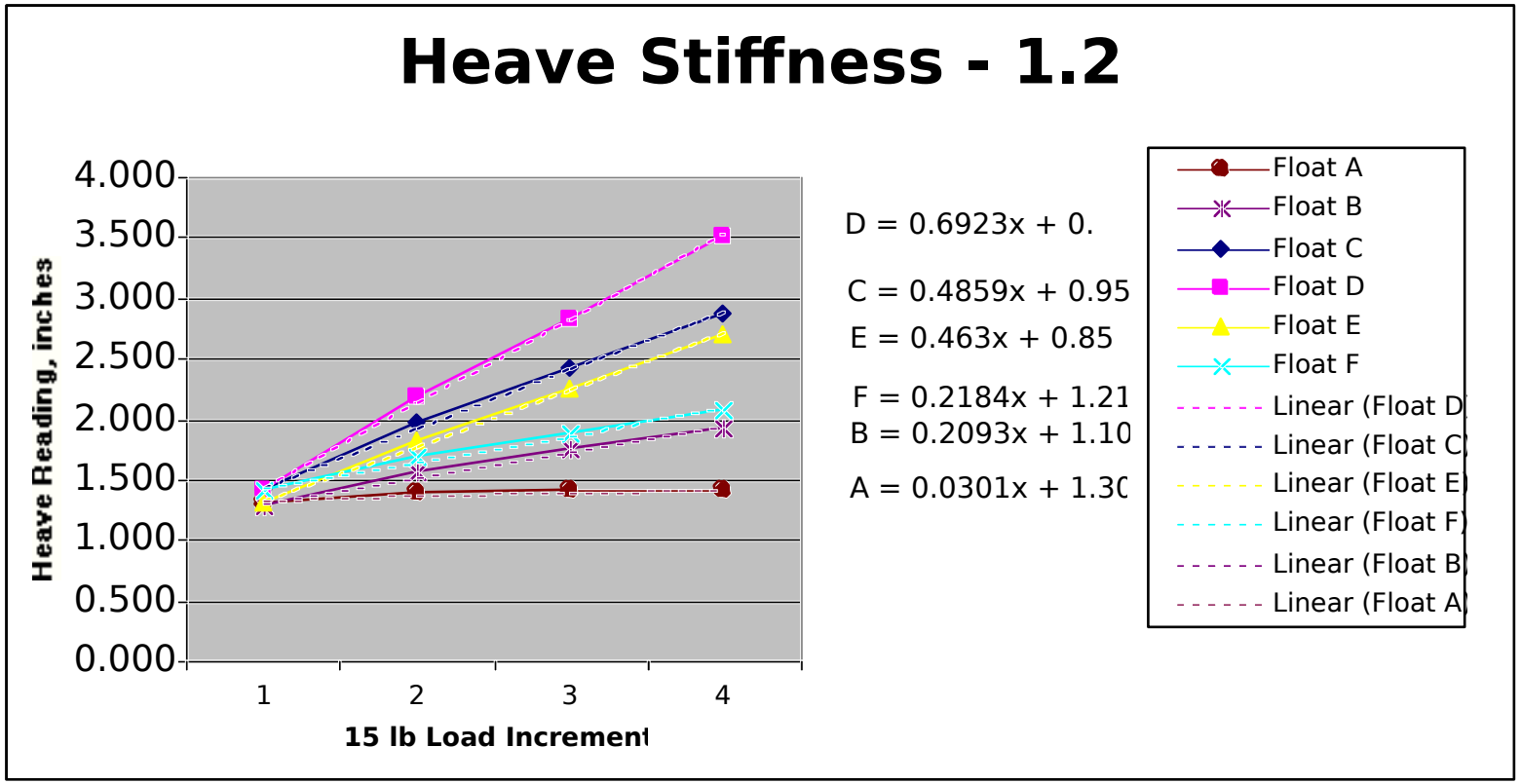
Runs 8-11. Heave stiffness increases with pressure

ERDC Engineer Research and Development Center

Quantum Engineering Design, Inc.

LIGHTWEIGHT MODULAR CAUSEWAY SECTION (LMCS)

1/12-Scale LMCS Buoyancy & Stability Tests



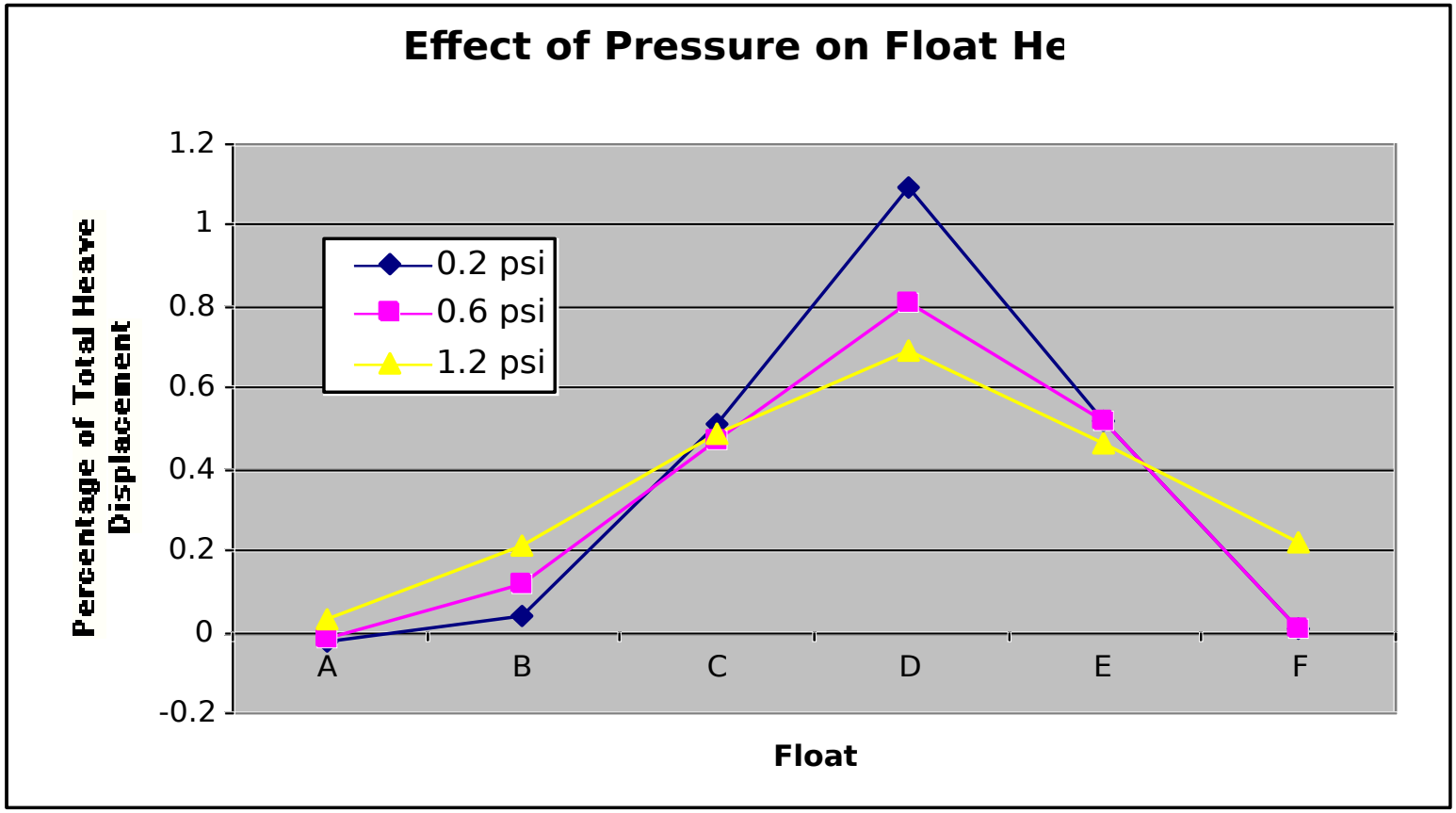
Runs 23-26. Heave stiffness increases with pressure

ERDC Engineer Research and Development Center

Quantum Engineering Design, Inc.

LIGHTWEIGHT MODULAR CAUSEWAY SECTION (LMCS)

1/12-Scale LMCS Buoyancy & Stability Tests



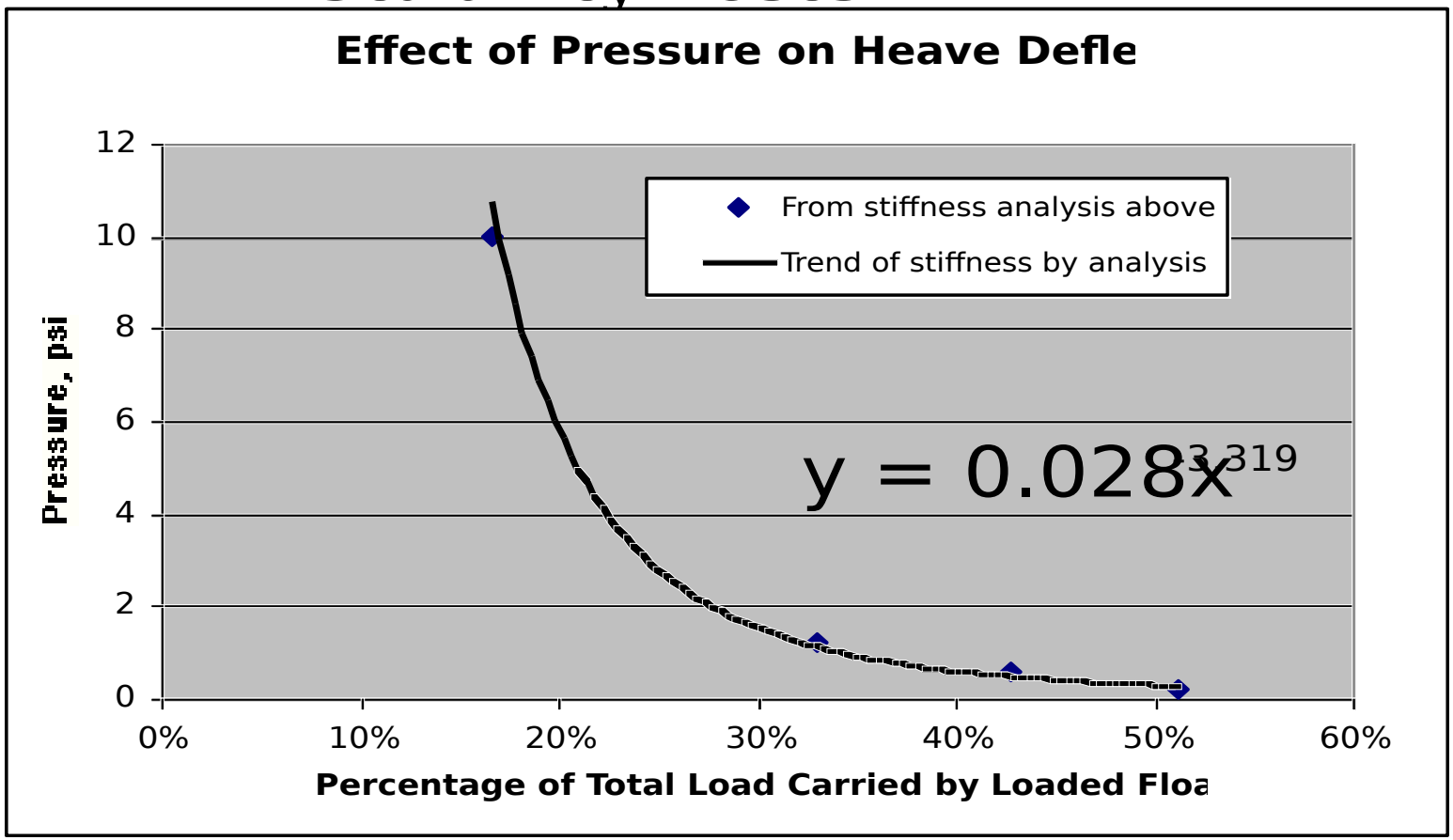
Load is supported by more floats as pressure is increased

ERDC Engineer Research and Development Center

Quantum Engineering Design, Inc.

LIGHTWEIGHT MODULAR CAUSEWAY SECTION (LMCS)

1/12-Scale LMCS Buoyancy & Stability Tests



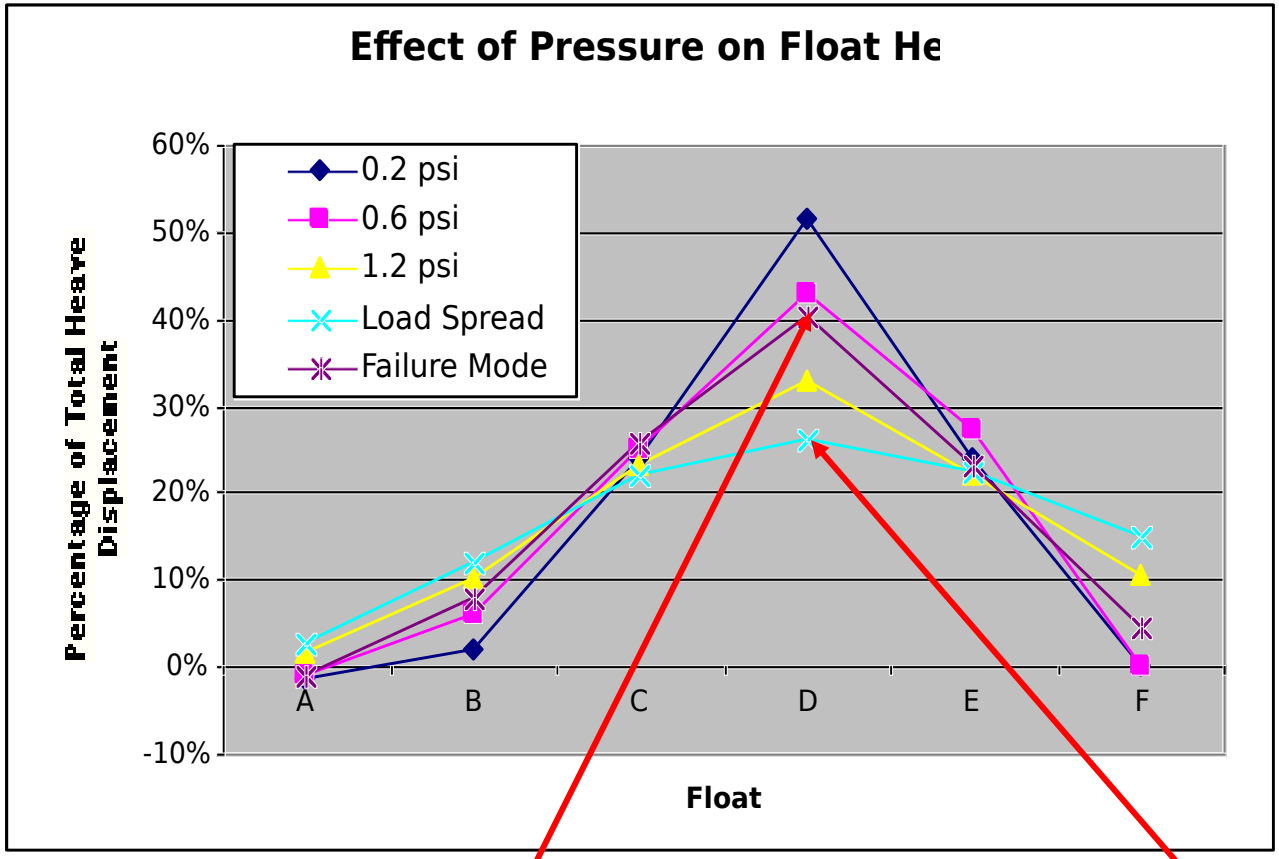
Increasing pressure makes causeway stiffer

ERDC Engineer Research and Development Center

Quantum Engineering Design, Inc.

LIGHTWEIGHT MODULAR CAUSEWAY SECTION (LMCS)

1/12-Scale LMCS Buoyancy & Stability Tests



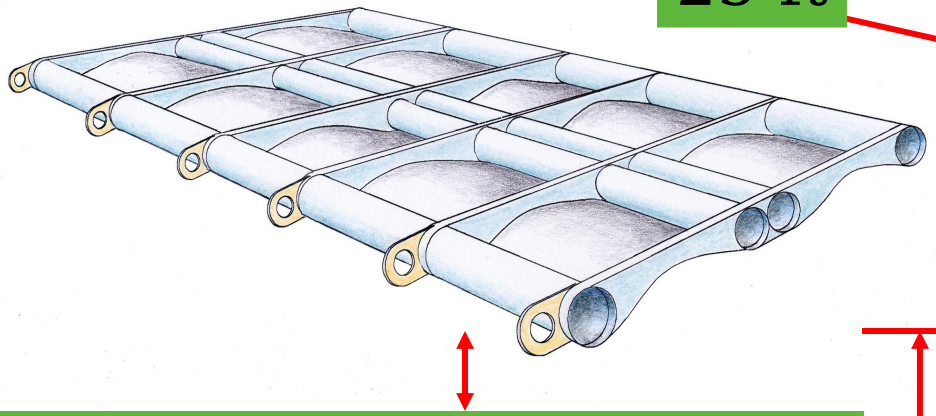
Demonstration of failure mode and effect of load spread

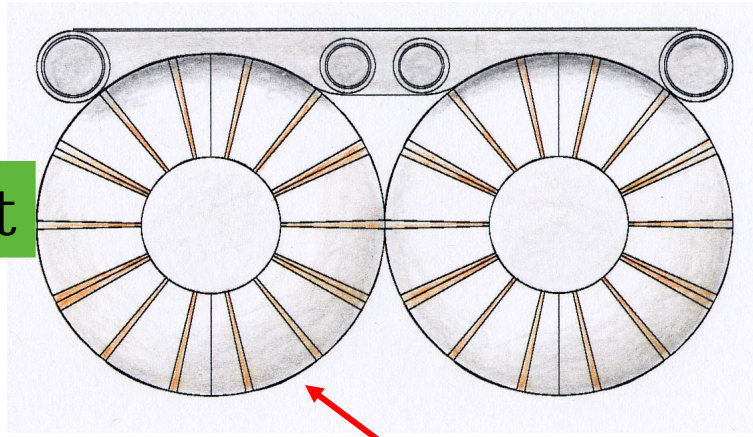
ERDC Engineer Research and Development Center

Quantum Engineering Design, Inc.

LIGHTWEIGHT MODULAR CAUSEWAY SECTION (LMCS)

Flotation Geometry Study

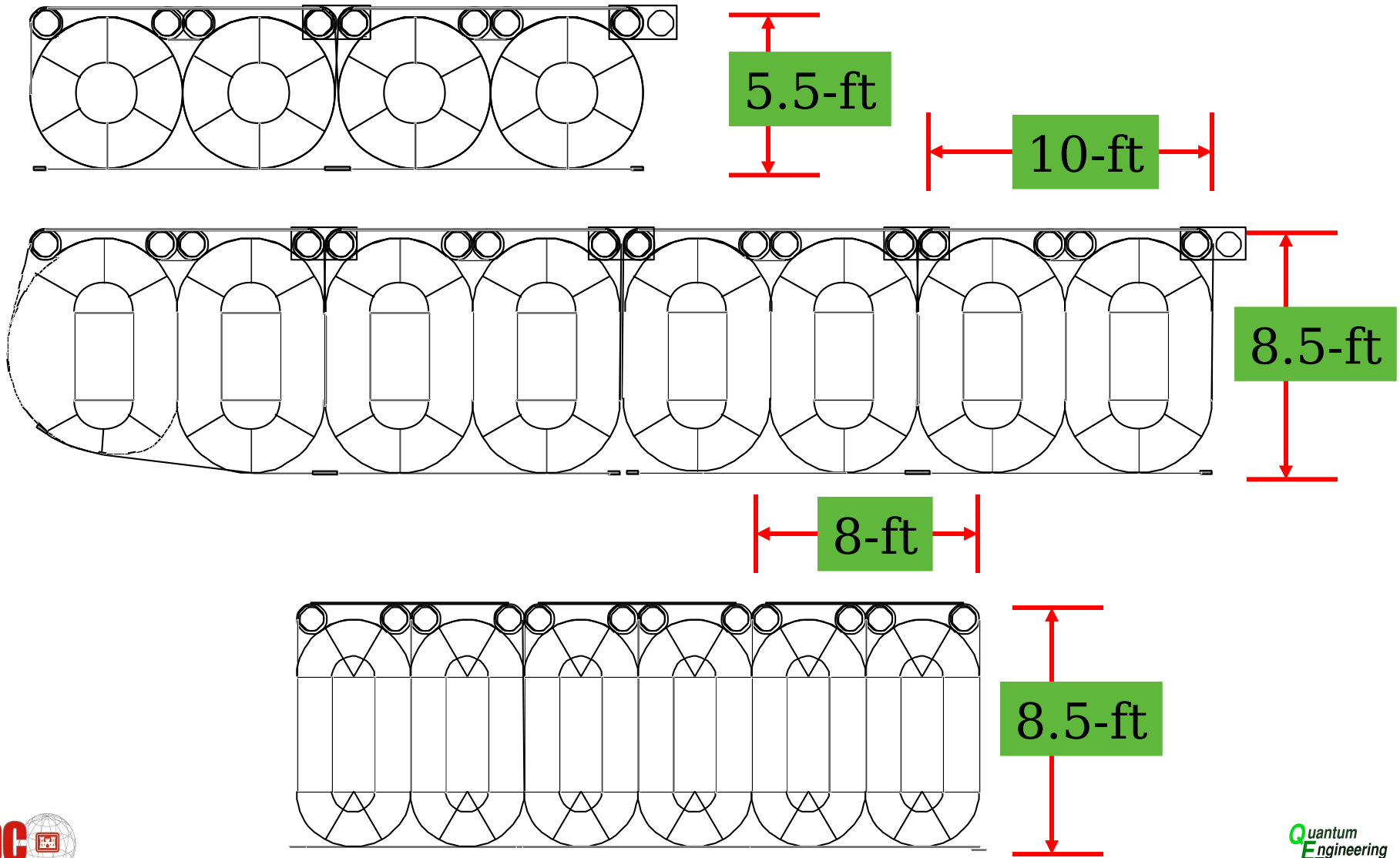




Baseline LMCS Concept Dimensions

LIGHTWEIGHT MODULAR CAUSEWAY SECTION (LMCS)

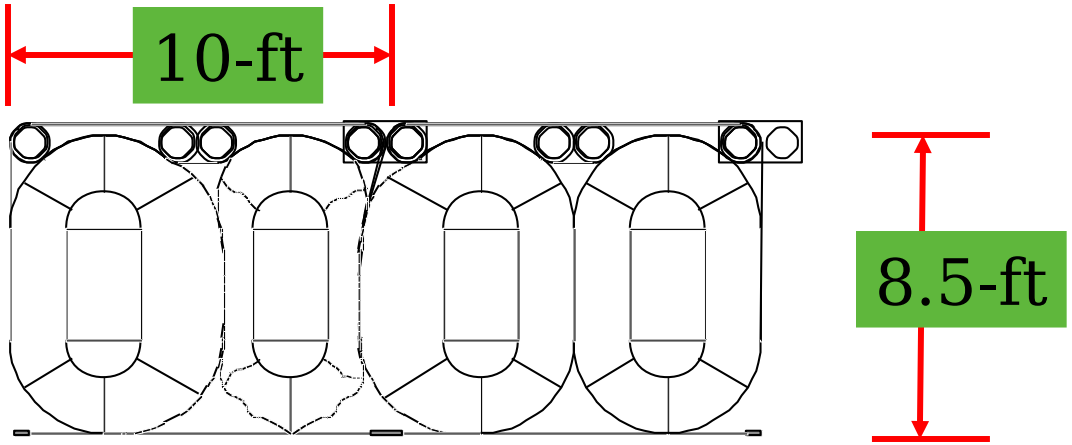
Flotation Geometry Study



ERDC Engineer Research and Development Center

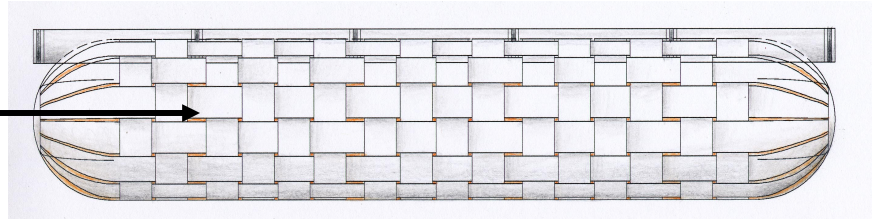
Quantum Engineering Design, Inc.

Damage Containment & Mitigation

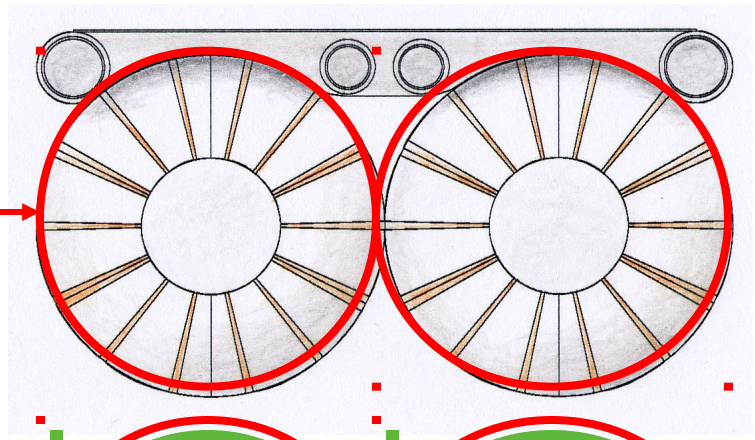


Air Containment Concepts

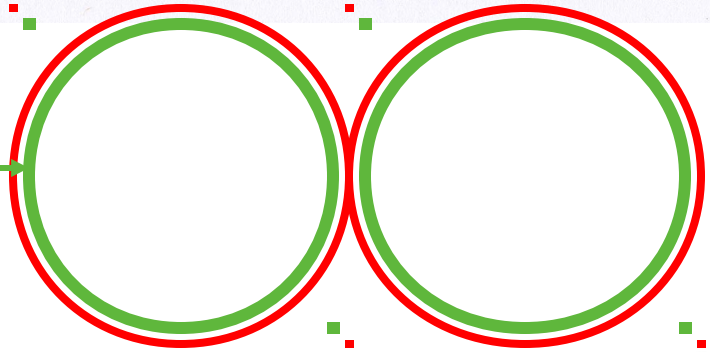
Tough exoskeleton of woven polyester webbing



Inner shell of elastomer coated fabric



Primary air containment bladder



LIGHTWEIGHT MODULAR CAUSEWAY SECTION (LMCS)

Summary

- LMCS 1/12th scale model tests provided:
  - Useful insights into flotation characteristics
  - An empirical data base for comparison with analytical models
  - Confirmation of pressure/stiffness relationship of strap constrained LMCS platform concept
- Geometry study confirms deeper platform can meet buoyancy/freeboard requirements
- Pressure bag failure modes analysis is ongoing exploring:
  - Puncture resistance using multi-layered containment system
  - Secondary (i.e backup) bladders
  - Foam filled for specific applications